E. VOLUNTEER MONITORING PROTOCOLS

There are two established programs for concerned citizens interested in volunteer stream monitoring in Fairfax County. The Audubon Naturalist Society, which coordinates a local program through the Webb Sanctuary in Clifton, Virginia, and the Northern Virginia Soil and Water Conservation District. The following pages consist of general and detailed volunteer monitoring instructions and the official data forms for the two organizations. The Northern Virginia Soil and Water Conservation District material is presented first, followed by the Audubon Naturalist Society forms. For even more detailed protocols or other general information call (703) 324-1425 to reach the Northern Virginia Soil and Water Conservation District or (301) 652-9188 to reach the Audubon Naturalist Society.

The Northern Virginia Soil and Water Conservation District's volunteer stream-monitoring program uses the Virginia Save Our Streams protocol. Compared with the Save Our Streams protocol developed by the Issak Walton League, this protocol consists of fine-tuning of the taxa tolerance ratings, such as the separation of net-spinning caddisflies from other less tolerant forms. The protocol also uses actual counts of insects, allowing a better definition of the community structure. Lastly, a quantitative multi-metric-index has been developed similar to the Benthic Index of Biotic Integrity to give an overall quantitative ranking of stream health.

In addition to learning about stream monitoring, many volunteers also become involved in watershed groups, clean-up programs, and educational programs. Newsletters and calendars are sent to about 700 people and forwarded to hundreds more, a very effective way to reach large numbers of existing and potential monitors.

Over 700 volunteers have participated in collecting data. Certified data is forwarded to Fairfax County, Department of Environmental Quality, Virginia Save Our Streams, and other interested organizations or individuals.

The Northern Virginia Soil and Water Conservation District would like to recognize the following outstanding volunteers: Blythe Merritt has been star volunteer for more than 5 years. Blythe not only monitors her healthy site on Cub Run, but also assists at many additional sites every season. Blythe introduces many new monitors to the joys of stream monitoring. She is active in watershed planning and stream cleanups.

Ivy Main and her daughter Llewelyn have been monitoring their backyard stream for more than 5 years. They usually include other family members and friends. Llewelyn is one of our younger monitors and has been certified since the age of 10.

Deana Crumbling and Jim McGlone found love as a result of being very dedicated stream monitors. Together, they monitor four sites and have volunteered hundreds of hours. Deana was our volunteer coordinator before a paid position was created.

Ivy Main and family

Deana Crumbling and Jim McGlone, who met through volunteer monitoring

The Audubon Naturalist Society uses a modified version of the U.S. EPA Rapid Bioassessment Protocol for benthic macroinvertebrates. They also combine visual habitat assessment with the benthic sampling. Invertebrates are identified to family, where possible, or to the highest taxonomic resolution practicable. Currently, the protocol does not include a biological rating system. Plans are underway to incorporate an Index of Biotic Integrity-type rating system into the protocol. This would allow much more direct comparison with professional data.

Renee Kitt, Audubon Naturalist Society Volunteer Coordinator (blue hat). (photo ANS)

Without the dedication and hard work of the volunteer water quality monitors, Audubon Naturalist Society would be unable to consistently collect high-quality data on local streams. Monitors also serve as ambassadors for streams to the larger community by sharing their experiences, knowledge, and concern with families, co-workers, and friends. Audubon Naturalist Society would like to recognize the following monitors active in Fairfax County:

Leslie Burke, Nancy Byrd, Bob Cantor, Amanda Hencken, Renee Kitt, Martha Lang, Virginia Lathrop, Bret Leslie, Peter Mecca, Blythe Merritt, Kurt Moser, Jerry Odhner, Lee Regan, Linda Rosen; Sandy and John Schaeffer, Jeff Schuman, Charles Smith, Neil Sullivan, and Karen Waltman.

Fairfax County Volunteer Stream Monitoring Program
Coordinated by the Northern Virginia Soil and Water Conservation District

VA Save Our Streams

Stream Quality Survey
Rocky Bottom Method

Biological Monitoring Directions

1. Place the net perpendicular to the flow of water immediately downstream of the sampling area. Remember that the area you are sampling and the duration is dependant on the abundance of life in your stream. You can sample areas of: 1 by 1 foot, 2 by 2 foot, or 3 by 3 foot. You can sample from 20-90 seconds. You take a maximum of 4 samples. If you are unsure, please ask for help.
2. Weight down the bottom of the net with rocks.
3. Sample the area for 20-90 seconds.
   - (adjustable - remember the goal is 200 bugs).
   - To sample, lift and rub underwater all large rocks.
   - Dig around in the small rocks and sediments to dislodge any burrowing macroinvertebrates.
4. After sampling, carefully rub off any rocks used to anchor the net.
5. Remove the net with an upstream scooping motion to keep all the macroinvertebrates in the net.
6. Place the net on a flat, light colored surface. Pick all the organisms off the net into the ice-cube tray.
7. Once all the macroinvertebrates are removed from the seine, count the number of organisms in the sample. If at least 200 organisms have not been sampled, another net must be collected from a different area in the same riffle or nearby riffle. The organisms from the second net will be added to the first. The length of sampling time can be adjusted depending on the number of organisms collected in the first, with the maximum sampling time per net being 90 seconds.
8. This process is repeated until at least 200 organisms are found or 4 nets are collected, whichever is first. Each net collected must be sorted in its entirety, even if that leads to a sample of well over 200 organisms.

REMEMBER THAT THE GOAL IS TO GET 200 BUGS or more.

Chemical Monitoring Directions
Hach Nitrate/Nitrite Test Strip Instructions

Prepared by Deana Crumbling

The Hach Test Strip is a quick, simple, and safe way to estimate the concentration of nitrate and nitrite in stream water. Nitrate (NO3-) and nitrite (NO2-) are forms of inorganic nitrogen that are very soluble in water and are readily taken up by plants. Nitrate is more common in streams than nitrite. The nitrite result will usually be "0" in streams unless the stream is being heavily impacted by a pollution source. Once in a while the nitrate result may be "0", but usually the result will be "0-1". The nitrate result may be higher than 1, especially if the water sample is taken when (or where) there is a lot of runoff entering the stream. Results higher than 5 should be double-checked, and reported for a follow-up investigation.

Increased amounts of nutrients in surface water cause algae blooms, which in turn cause other problems for streams. Increased levels of nutrients in Fairfax County streams reach the Chesapeake Bay where they contribute to the destruction of Bay habitat and fisheries.

In Fairfax County (where agriculture has been largely replaced by suburban development), fertilizer runoff (from lawns and golf courses) is the predominant source of nitrate to streams. The presence of nitrate from fertilizer also indicates that other applied lawn chemicals directly toxic to stream ecosystems, such as herbicides and insecticides, may be running off into streams. Another chronic source of nitrate addition is the atmospheric deposition of automobile emissions to impervious surfaces. Stormwater runoff then carries the excess nutrients directly into streams.

Leakage from sewer lines running alongside or under streams can cause very high levels of nitrate, and the nitrate can be used as a marker to localize the leak. Septic systems can also leak nitrate into nearby streams. Sewage leaks can contribute harmful bacteria and viruses to streams that drain into drinking water reservoirs.

Directions

1. Be sure to replace the cap immediately when removing a strip from the bottle. The test strips are sensitive to moisture in the air.
2. Hold a test strip by the bare end. When dipped in water containing these nitrogen species, the pads will develop a pink color, which is matched to the color blocks on the outside of the bottle. Do not hold a wet test strip against the bottle. The water will ruin the color blocks and make them difficult to read.
3. A test strip is dipped into the water for 1 second. You can collect a fresh water sample in a clean container or dip the strip directly into the stream.
4. Time for 30 seconds and then look at the nitrite test pad on the strip. If there is no pink color, the test is negative, and the result can be recorded by circling the "0" in the nitrite row. If there is pink color, but it is not as dark pink as the 0.15 color block, circle the "0-0.15" option on the Sheet. If the pink color looks exactly the same as the 0.15 color block, circle the "0.15" option on the Sheet, and so on. At 60 seconds after dipping the strip, match up the nitrate test pad in the same way, and circle the appropriate option on the Sheet.

Chemical Monitoring Directions
Turbidity Instructions
Prepared by Deana Crumbling

Turbidity is the measure of the cloudiness of water. It is important because…

Remember: It is more accurate to perform the test immediately at stream-side. To do so, you must take along a small bottle of tap water.

1. Fill one of the cylinders to the 50 mL mark with stream water and the other with tap water. If the water appears very turbid/cloudy, fill the cylinders only to the 25 mL mark.
2. SHAKE the bottle of Standard Turbidity Reagent vigorously to resuspend the latex particles in the reagent.
3. To the cylinder containing TAP WATER, use the dropper to add Standard Turbidity Reagent in 0.5 mL increments-(NOT drop-by-drop). Add 1 squirt of 0.5 mL Reagent, then use the plastic stirring rod to mix.
4. Compare the fuzzy appearance of the black dot at the bottom of the tap water cylinder with the dot in the stream water cylinder (DO NOT try to match the color-the latex particles are white and will never match the brownish or greenish tint of most stream water). The goal is to add enough of the Standard to the tap water so that the cloudiness (as judged by the appearance of the black dots) of the tap water is made to match that of the stream water.
5. Count the number of "squirts" required to get a match. Read the turbidity (in units called JTU) off the chart on the kit's package insert/directions. Make sure you read off the correct column-one column is for use with a 50-mL volume, the other column is for a 25-mL volume.
6. On the reporting sheet, fill in the result and the number of squirts and test volume used. Examples: 15 JTU (3 squirts/50 mL) or 30 JTU (3 squirts/25 mL)
7. If the stream water looks just as clear as the tap water, report the result as "less than 2.5 JTU" by circling that option on the SOS Report Sheet.
8. If the stream water looks a little more cloudy than the tap water at the start, but when you add 1 squirt of turbidity reagent it looks like the tap water column becomes much cloudier than the stream water, report the result as "about 2.5 JTU" by circling that option on the Sheet.

Tip: If you are not sure if you have a match, add another squirt of turbidity reagent. If you can see that you've "gone ever," you can feel sure that the previous number of squirts was indeed the correct number.

Note: You may interpolate your result, if you wish. For example, if the match seems like it was between squirts 2 and 3 for a 50 mL volume, you could report the result as " ~12.5 JTU" (which means "about half-way between 10 and 15 JTU"). Or you could use the higher number (15 JTU) or the lower number (10 JTU), whichever one you feel is closest to the match. Any of these choices is acceptable, since the turbidity measurement is only an estimate.

Turbidity Test Results

Number of Measured Additions	Amount in mL	50 mL Graduation	25 mL Graduation
1	0.5	5 JTU	10 JTU
2	1.0	10 JTU	20 JTU
3	1.5	15 JTU	30 JTU
4	2.0	20 JTU	40 JTU
5	2.5	25 JTU	50 JTU
6	3.0	30 JTU	60 JTU
7	3.5	35 JTU	70 JTU
8	4.0	40 JTU	80 JTU
9	4.5	45 JTU	90 JTU
10	5.0	50 JTU	100 JTU
15	7.5	75 JTU	150 JTU
20	10.0	100 JTU	200 JTU

Submission of Data

You have plenty of choices for your convenience.

Regular mail:
Northern Virginia Soil and Water Conservation District
Attn: Volunteer Stream Monitoring Coordinator
12055 Government Center Parkway, Suite 905
Fairfax, VA 22035

Email:
You can scan the forms if you have access to a scanner and send them as an attachment.
jarcisze@gmu.edu

You can use the Excel spreadsheet and email that as an attachment to jarcisze@gmu.edu.

You can type into the Word document and email that as an attachment to jarcisze@gmu.edu.

Fax:
You may fax the form to the number: (703) 324-1421

Figure E1: Data sheet for the Volunteer Stream Monitoring (front).

Fairfax County Volunteer Stream Monitoring Program

Coordinated by the Northern Virginia Soil and Water Conservation District

VA Save Our Streams Stream Quality Survey

Rocky Bottom Method

For Office Use Only
Name of Reviewer_____________________________

Date Reviewed________________________________

Data Sent To_________________________________

The purpose of this form is to aid you in gathering and recording important data about the health of your stream. By keeping accurate and consistent records of your observation and data from your macroinvertebrate count, you can document changes in water quality. When conducting rocky bottom sampling, select a riffle where the water is not running too fast, the water depth is between 3-12 inches, and the bed consists of cobble-sized stones (2 to 10 inches) or larger.

Stream____ Station #______________ # of Participants________________

County________________________ State_______ Latitude______________________ Longitude____________________________

Location (please be specific) ____

Names of Participants____

Name of Certified Monitor____

Weather Conditions Last 72 Hours____

Date_________________ Stream (water) width____________ft Channel (bank-to-bank) width_____________ft

Start Time___________ End Time___________ Stream Flow Rate: High______ Normal_____ Low______ Negligible_______

Water depth in riffle _________ in. Average stream depth_________ft Water temp_______ °F or °C Air temp________ °F or °C

Biological Monitoring Collection Times

Collection Time:

Net 1:______sec Area sampled:_______

Net 2:______sec Area sampled:_______

Net 3:______sec Area sampled:_______

Net 4:______sec Area sampled:_______

Comments related to sampling:

____

____

____

____

____

Chemical Tests (refer to NVSWCD instructions as needed):

Nitrite/Nitrate Test Strip Results (circle)	LaMotte Kit **Turbidity** Results, JTU (circle)
Nitrite Nitrogen, ppm (mg/L): 0 0-0.15 0.15 0.15-0.3 0.3 >0.3	Vol: 25 or 50 mL <2.5 ~2.5 5 10 15 20
Nitrate Nitrogen, ppm (mg/L): 0 0-1 1 1-2 2 2-5 5 >5	# squirts: ______ 25 30 35 other: ______

Are there any discharging pipes? □ No □ Yes If yes, how many? ________

What types of pipes are they? □ Sewage treatment □ Runoff (field or stormwater) □ Industrial: type of industry _____________

Describe types of trash in and around the stream.

____

Provide comments to indicate what you think are the current and potential future threats to your stream's health. Feel free to attach additional pages or photographs to better describe the condition of your stream. __________________________________

____

____

____

Figure E2: Data sheet for the Volunteer Stream Monitoring (back).

HABITAT ASSESSMENT
NORTHERN VIRGINIA SOIL AND WATER CONSERVATION DISTRICT
VOLUNTEER STREAM MONITORING PROGRAM

Stream: ________________

Station #: _______________

Date: ___________________

Fish Water Quality Indicators:
- ☐ scattered individuals
- ☐ scattered schools
- ☐ trout (pollution sensitive)
- ☐ bass (somewhat sensitive)
- ☐ catfish (pollution tolerant)
- ☐ carp (pollution tolerant)

Barriers to Fish Movement:
- ☐ beaver dams
- ☐ man-made dams
- ☐ waterfalls (>1ft)
- ☐ other
- ☐ none

Salamanders:
- ☐ present
- how many? _________
- ☐ none

Surface Water Appearance:
- ☐ clear
- ☐ clear, but tea-colored
- ☐ colored sheen (oily)
- ☐ foamy
- ☐ milky
- ☐ cloudy/turbid
- ☐ muddy
- ☐ other ____________

Stream Bed Deposit (Bottom):
- ☐ gray
- ☐ orange/red
- ☐ yellow
- ☐ black
- ☐ brown/tan
- ☐ silty/muddy
- ☐ sandy
- ☐ other________________

Odor:
- ☐ rotten eggs
- ☐ musky
- ☐ oil
- ☐ sewage
- ☐ other______________
- ☐ none

Stability of Stream Bed:
Bed sinks beneath your feet in:
- ☐ no spots
- ☐ a few spots
- ☐ many spots

Coverage of Stream Bank by Plants, Rocks, Logs, etc. (vs. exposed soil):	Good	Fair	Poor
	(>70%)	(30-70%)	(<30%)
- Stream banks (sides)	☐	☐	☐
- Top bank (slope and floodplain)	☐	☐	☐

Algae Located:
- ☐ everywhere
- ☐ in spots
- _____% of bed covered
- ☐ none

Algae Color (if present):
- ☐ light green
- ☐ dark green
- ☐ brown coated
- ☐ matted on stream bed
- ☐ hairy/filamentous

Describe Stream Bank sides and Top:
(Mostly shrubs or trees or paved or soil)
____
____
____
____
____

Stream Channel Shade:
- ☐ >80% excellent
- ☐ 50% - 80% high
- ☐ 20% - 49% moderate
- ☐ <20% almost none
- ☐ <20% winter/leaf off

Stream Bank Erosion:
- ☐ >80% severe
- ☐ 50% - 80% high
- ☐ 20% - 49% moderate
- ☐ <20% almost none

Pebble Count Results (optional)
100 pebble count
- _____ # silt (< 1/4" grains)
- _____ # sand (1/16" - 1/4" grains)
- _____ # gravel (1/4" - 2" stones)
- _____ # cobbles (2" - 10" stones)
- _____ # boulders (>10" stones)

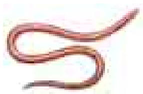
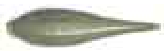
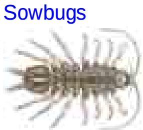
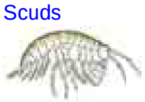
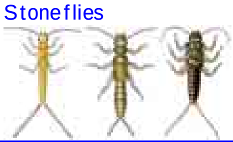
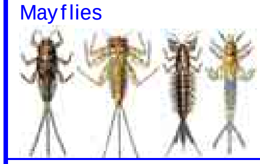
Land Uses in the Watershed: Look at a map. Walk your stream in your area. Record all land uses in the watershed area upstream and surrounding your site. Indicate whether these land uses have a High (**H**), Moderate (**M**), Slight (**S**), or No (**N**) potential (even if present) to impact the quality of your stream. If the land use is not present in your watershed, record **NP** for Not Present. Leave blank if unsure.

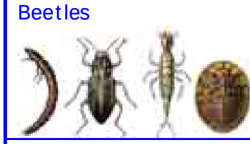
- ____ Housing Developments
- ____ Forest
- ____ Logging
- ____ Urban Uses (e.g., parking lots, highways, etc.)
- ____ Sanitary Landfill
- ____ Active Construction
- ____ Cropland
- ____ Recreation
- ____ Trash Dump
- ____ Fields
- ____ Livestock Pasture
- ____ Other __________________________
____

Please return completed form to: Northern Virginia Soil & Water Conservation District
12055 Government Center Parkway, Suite 905, Fairfax, Virginia 22035
Phone: (703) 324-1425 Fax: (703) 324-1421
Jarcisze@gmu.edu

Figure E3: Field sheet for the Volunteer Stream Monitoring (1 of 3).

Virginia Save Our Streams Macroinvertebrate Tally Sheet

Macroinvertebrates	Tally	Count
Worms 		
Flat Worms 		
Leeches 		
Crayfishes 		
Sowbugs 		
Scuds 		
Stoneflies 		
Mayflies 		
Dragonflies and Damselflies 		
Hellgrammites, Fishflies, and Alderflies 		

Macroinvertebrates	Tally	Count
Common Netspinner Caddisfly 		
Most Caddisflies 		
Beetles 		
Midges 		
Black Flies 		
Most True Flies 		
Gilled Snails 		
Lunged Snails 		
Clams 		
Other		
Total number of organisms in the sample		

Illustrations from: Voshell, J. R., Jr. 2001. Guide to the Common Freshwater Invertebrates of North America. MacDonald and Woodward Publishing Co. With permission of the author.

Figure E4: Field sheet for the Volunteer Stream Monitoring (2 of 3).

Individual Metrics

Metric	Number		Total number of organisms in the sample		Percent
Mayflies + Stoneflies + Most Caddisflies		Divide by		Multiply by 100	
Common Netspinners		Divide by		Multiply by 100	
Lunged Snails		Divide by		Multiply by 100	
Beetles		Divide by		Multiply by 100	

% Tolerant

Taxon	Number
Worms	
Flatworms	
Leeches	
Sowbugs	
Scuds	
Dragonflies and Damselflies	
Midges	
Black Flies	
Lunged Snails	
Clams	
Total Tolerant	
Total Tolerant divided by the total number of organisms in the sample	
Multiply by 100	

% Non-Insects

Taxon	Number
Worms	
Flatworms	
Leeches	
Crayfish	
Sowbugs	
Scuds	
Gilled Snails	
Lunged Snails	
Clams	
Other non-insects (organisms without 6 jointed legs)	
Total Non-Insects	
Total Non-Insects divided by the total number of organisms in the sample	
Multiply by 100	

Figure E5: Field sheet for the Volunteer Stream Monitoring (3 of 3).

Save Our Streams Multimetric Index

Determine whether each metric should get a score of 2,1, or 0. Write your metric value from the previous page in the 2nd column (Your Metric Value). Put a check in the appropriate boxes for 2,1, or 0. Then calculate the subtotals and Save Our Streams Multimetric Index score and determine whether the site has acceptable or unacceptable ecological condition.

Metric	**Your Metric Value**	**2**	**1**	**0**
% Mayflies + Stoneflies + Most Caddisflies		Greater than 32.2	16.1 – 32.2	Less than 16.1
% Common Netspinners		Less than 19.7	19.7 – 34.5	Greater than 34.5
% Lunged Snails		Less than 0.3	0.3 – 1.5	Greater than 1.5
% Beetles		Greater then 6.4	3.2 – 6.4	Less than 3.2
% Tolerant		Less than 46.7	46.7 – 61.5	Greater than 61.5
% Non-Insects		Less than 5.4	5.4 – 20.8	Greater than 20.8
		Total # of 2s:	Total # of 1s:	Total # of 0s:
Subtotals:		Multiply by 2:	Multiply by 1:	Multiply by 0:

Now add the 3 subtotals to get the Save Our Streams Multimetric Index score:________________

_____Acceptable ecological condition (7 to 12) _____Unacceptable ecological condition (0 to 6)

Data Collection Protocol for Piedmont Streams

2001

Within each sample site, a representative sample reach is selected. Each sample reach should be a minimum of one riffle-pool-riffle sequence. The riffles should have a substrate of cobble and rubble (2"-10" stones), gravel and sand. Water depth should be less than 1 foot. Water velocity should be at least sufficient to carry dislodged stream bed material downstream approximately 12-16 inches. Pools should have coarse particulate matter (sticks, roots, leaves) and a slower water velocity. Pools may be deeper than 1 foot.

Complete Site Information, Habitat Assessment, and Abiotic Data sections of the Stream Quality Survey form BEFORE you begin collecting macroinvertebrates.

A. TEMPERATURE COLLECTING METHOD

1. To take the ambient air temperature:

    a) Hold or hang thermometer in shaded area approximately 3 feet above ground.
    b) Wait at least 3 minutes before reading.
    c) Record air temperature and time of day on data sheet.
    d) Record Celsius temperature, then use conversion formula to determine Fahrenheit temperature. Record Fahrenheit temperature.

2. To take the water temperature:

    a) Totally submerge the thermometer within the pool sampling area for a minimum of three minutes by placing the thermometer inside a 1 pint clear container and placing the thermometer and container in stream.
    b) Remove the container from the stream, keep thermometer bulb in water-filled container and read water temperature as quickly as accuracy permits.
    c) Repeat this two more times in different areas of your reach, then record the average temperature in both Celsius and Fahrenheit.

B. PH COLLECTING METHOD

Rinse tube first with stream water. Follow instructions accompanying the pH kit and record reading on data form. Dispose of solution on land, <u>then rinse tube in stream</u>.

C. EMBEDDEDNESS MEASUREMENTS

Embeddedness is defined as the degree to which larger substrate materials (gravel, rubble, cobble, boulder) are surrounded or covered by sand/silt. Four embeddedness readings will be taken and recorded: two each in the downstream and upstream riffle areas.

1. Begin in the downstream riffle area. Make the first observation near the midpoint of the riffle area as measured from streambank to streambank. The second observation in the downstream riffle area should be taken near the left streambank, when looking upstream.

2. Use the half-square to frame the observation area, placing it under water within the riffle to define the area being measured for embeddedness.

3. Observe the tops, then the sides of all rocks > 3 inches across. Gently pick up several rocks, one at a time, from the sample area and watch for plumes of silt as you move them. Record embeddedess values.

4. Repeat the midpoint and left side observations in the upstream riffle and record embeddedness values.

D. BENTHIC MACROINVERTEBRATE COLLECTING METHOD

1. Macroinvertebrate collection will begin in the riffle area farthest downstream in your reach.

    a) Position the D-net about 12-16 inches downstream of the collector in a portion of the riffle where the water current will carry dislodged material into the net. Select one team member to hold the D-net so that the flat end is flush with the stream bottom. Select one or more other team members to carefully and gently wash all benthic macroinvertebrates from the rocks within a 1 foot square area immediately upstream of the net. As each rock is cleaned, place it outside of the sample area. After all rocks have been cleaned, carefully use the hand to disturb the stream bed sand and small rocks to a depth of 3 inches. (If stream bed appears to be littered with glass or other sharp objects, use your feet instead of your hands.)

    b) Collect at three spots within your downstream riffle for a duration of one minute per spot. Choose three spots which represent different microhabitats: e.g. areas with different sized stones, areas with more/less leaf matter, areas with faster/slower water. If there are leaf packs between the substrate materials, be sure to rinse them off in front of the net to collect the organisms which may be feeding/hiding on them.

    c) After collecting at each of three spots in the downstream riffle, return all the rocks to their 1 square foot sampling area.

    d) Before emptying the collected material into the pans, pour streamwater through the net and its contents until the water runs clear. This is a particularly important step for the pool sample and for streams where sediment is a problem. This should help reduce the murkiness of the water which can make finding and sorting macros so difficult.

    e) Empty the net contents into the white pans (see step f) for directions) <u>BUT DO NOT BEGIN TO SORT AND IDENTIFY MACROS until you have repeated the collecting procedures in the upstream pool and then the upstream riffle end of your reach.</u> Collecting at each of these sections should follow the same procedure as for the downstream riffle: collect at three different spots within the section for a period of one minute of scrubbing/agitating per spot. In the pool section, samples should be taken from leaf packs and root balls/masses, as well as the substrate.

f) Empty the net contents into the white pans. Invert the net and wash it with stream water, letting the water run through the net into the collection container, to dislodge any benthic macroinvertebrates that may have attached to the net. Check the net for macroinvertebrates that still remain attached and remove them, using forceps, to the collecting container. Remove collected organic matter (leaves, sticks) from the collecting container, being careful to check for and remove macroinvertebrates which may be attached. Return this "picked over" organic matter to the stream.

2. Sort and identify a subset (100 organisms) of the collected macros to Order (for insects and crustaceans) or Class (for leeches, aquatic worms, bivalves and gastropods).

   a) Try to correct the bias toward selecting larger organisms by picking our several large, then several small, etc.

   b) *Using the Lehmkuhl key & keys from the MACRO ID II classes, take time to determine discernibly different forms of the Orders: i.e., different Families and, in some cases, genera. This will take extra time, but it makes our data more useful and gives us a more detailed picture of the site's condition.* If you feel you don't have the skills or the time to ID down to the Family level, please separate out the different forms and return one of each different form in the bottle of alcohol. Make note on the data sheet how many of each form you found, as well as some descriptive language so we can match up the family--once it's identified--with the numbers in which you found it.

   c) If you cannot identify an individual(s), place in the vial of alcohol and return with the data sheets. Note the date and team number on the vial's label.

3. Record number of individuals per Order/Class on the main survey form and *the number of individuals per Family on the MD Benthos Taxonomic Key.* Sort and record until 100 individuals have been identified. STOP SORTING/IDENTIFYING ONCE YOU HAVE REACHED 100.

4. If 100 individuals cannot be sorted and identified, repeat Step 3: i.e. make a collecting "sweep" through your riffle-pool-riffle reach.

   a) Sort and ID until a total of 100 individuals has been identified.
   b) If you still do not reach 100 individuals, do NOT collect again. Return all benthic macroinvertebrates proportionately to the sample areas.

5. Make sure all information is recorded in the proper place on the field data sheets.
6. Once you have conducted the macroinvertebrate collection and have checked to make sure the Stream Quality Survey form is complete, make sure all of the monitoring equipment is gathered together to be returned with the Survey form.

_____ 1 hand lens
_____ 1 pint jar
_____ 1 thermometer
_____ 2 field microscopes
_____ 2 forceps
_____ 2 medicine droppers
_____ 2 pencils
_____ 2 plastic spoons
_____ 2 vials of alcohol

_____ 3 ice cube trays

_____ clipboard
_____ data survey sheet
_____ 3 collecting pans
_____3 plastic cups/bowls
_____ pH kit
_____ D-net
_____ embeddedness bar
_____ 3 "scope" dishes
_____macroinvertebrate keys
(Lehmkuhl, Ohio DNR key)

Thank you returning the equipment as soon as it is feasible. There are not enough sets of equipment for every team.

Figure E6: Field sheet for the Volunteer Stream Monitoring (front).

AUDUBON NATURALIST SOCIETY Date:____________

STREAM QUALITY ASSESSMENT SURVEY

AUDUBON NATURALIST SOCIETY

Data Collectors' Name(s) ____________ Team Leader Phone #

____________ ____________

____________ ____________

SITE INFORMATION

Watershed ____________

Stream ____________ Order______ Site No. ______ Season/year:____________

County ____________ State ___ Specific Location ____________

HABITAT ASSESSMENT

Choose an appropriate reach (riffle-pool-riffle stretch of stream) for macroinvertebrate collection, then conduct this assessment BEFORE collecting macroinvertebrates. Check box which best represents actual conditions.

1. BED COMPOSITION OF RIFFLES

Riffle 1	Riffle 2	
______	______	% silt (mud)
______	______	% sand (1/16" - 1/4" grains
______	______	% gravel (1/4" - 2" stones)
______	______	% cobbles (2" - 10" stones)
______	______	% boulders (>10" stones)

Make sure these total 100%

2. EMBEDDEDNESS

Percentage of substrate (stream bottom) covered or surrounded by sediments. Check (✓) for each.

Riffle 1 Center	Riffle 1 Left		Riffle 2 Center	Riffle 2 Left
______	______	less than 25%	______	______
______	______	25 - 50%	______	______
______	______	50 - 75%	______	______
______	______	more than 75%	______	______

Embeddedness Values:

EXCELLENT less than 25%. Tops of the majority of rocks > 3 inches across are clean of silt or sediment. Sides of the majority of rocks > 3 inches across are not surrounded by silt or sediment. Plume of sediment almost nonexistent. Most rocks look as if they have been set on the stream bed.

GOOD 25 to 50%. Tops of the majority of rocks > 3 inches across are clean of silt and sand. Sides of the majority of rocks are surrounded, or mostly surrounded, by silt or sediment giving them a "cemented in" look. Plume of sediment small to moderate.

FAIR 50 to 75%. Tops of the majority of rocks > 3 inches across are partially covered by silt or sediment. Sides of the majority of rocks are surrounded by silt or sedimnent giving them a "cemented in" look. Plume of sediment moderate to extensive.

POOR . more than 75%. Tops of the majority of rocks are covered by silt or sediment. Sides of a majority of rocks are surrounded by silt or sediment giving them a "cemented in" look. Sediment plume extensive.

3. STREAMSIDE COVER

- ☐ Dominant vegetation trees with thick shrub/grass and perennial understory.
- ☐ Dominant vegetation trees with sparse perennial/ annual understory.
- ☐ Dominant vegetation woody shrubs and annuals.
- ☐ Majority plants present are annuals.

ABIOTIC DATA

Time ____________ pH ________

Water temperature ____C ____F [F=(1.8 x C) + 32]

Ambient air temperature _____C ____ F

General weather conditions ____________

Date/time of last rainfall (if known) ____________

Return form to: Audubon Naturalist Society, 8940 Jones Mill Road, Chevy Chase, MD 20815 (301) 652-9188

or

Webb Sanctuary, 12829 Chestnut Street, Box 51, Clifton, VA 20124-0051 (703) 803-8400

Figure E7: Field sheet for the Volunteer Stream Monitoring (back).

HABITAT ASSESSMENT

Habitat Parameter	Optimal 20-19-18-17-16	Sub-optimal 15-14-13-12-11	Marginal 10-9-8-7-6	Poor 5 -4-3-2-1-0
Channel Flow Score ☐ Comments:	Water reaches base of both banks; and minimal amount of channel substrate exposed.	Water fills more than 75% of available channel.	Water fills 25-75% of the available channel; and/or riffle substrates mostly exposed.	Very little water in channel, and mostly present as standing pools.
Bank Stability Score ☐ Comments:	Banks stable; no evidence of erosion or bank failure; side slopes; little potential for future problems.	Moderately stable; infrequent, small areas of erosion mostly healed over; slight potential in extreme floods.	Moderately unstable; moderate frequency and size of erosional areas; high erosion potential during extreme high flow.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends.
Bottom Deposition in Slow Areas of Stream Score ☐ Comments:	Less than 5% of the bottom affected by scouring and/or deposition.	5 - 30% affected; scour at constrictions and where grades steepen; some deposition in pools.	30 - 50% affected; deposits and/or scour at obstruction, constriction, and bends; filling of pools prevalent.	More than 50% of the bottom changing frequently; pools almost absent due to deposition; only large rocks in riffle exposed.
Riparian Forest Zone Width (Least Buffered Side) Comments: Score ☐	Width of riparian forest zones > 54feet; human's activities have not impacted this zone.	Zone between 36-54 feet; human's activities have impacted this zone only minimally	Zone between 18 and 36 feet; human's activities have impacted the riparian zone a great deal.	Zone 18 feet: little or no riparian forest due to man-induced activities (i.e. parking lots, roadbeds, clearcuts, lawns, or crops).
Total score ☐				

ADDITIONAL WATERSHED OBSERVATIONS

Canopy Cover (check one):

_____ Fully shaded _____more shaded than open _____More open than shaded _____Open

Comments:____

Turbidity (check one):

_____Clear _____Slightly turbid (cloudy) _____Turbid (very cloudy) _____Opaque (no light transmission)

Comments:____

Stream bank (observe bank from water line to 6" up the bank slope)

Soil color ______________________________

Soil type or mix of types (choose from list below) ______________________________

- Sandy. Porous soils, you can see sand grains.
- Loamy. Rich in humus or organic material, dark in color.
- Clay. Nonporous, when squeezed between thumb and forefinger, clay soils usually stick together.

F. IMPAIRED WATERBODIES

There are 19 Category 5 waterbodies (*impaired – requiring a TMDL*) with drainage areas in Fairfax County included in Virginia Department of Environmental Quality's 2004 Integrated Report. A summary of the Category 5 waterbodies in Fairfax County is provided in Table F1, and their locations are shown in Figure F1.

Of the listed waterbodies, 12 are riverine systems totaling 58.45 miles, six are estuarine systems with a total area of 23.23 square miles, and one is a drinking water reservoir with an area of 1,700 acres. The cause of impairment for the majority of the riverine waterbodies is either fecal coliform or general standards (benthic). For the estuarine waterbodies, the cause of impairment for the majority of systems is PCBs in fish tissue and fecal coliform. Ten of the 19 waterbodies are multi-jurisdictional i.e. include drainage areas outside Fairfax County. According to the current schedule, seven waterbodies require TMDL studies to be completed by 2010, nine require studies to be completed by 2014, with three to be completed by 2016.

Notes:

1. Several waterbodies in previous listing cycles have additional impairment causes shown in the 2004 report, mainly for fecal coliform. (This is usually due to the change in the bacteria water quality standard from 1,000 cfu/100mL to 400 cfu/100mL, which went into effect in February, 2004.)
2. Several waterbodies are listed as "fully supporting with an observed effect" for additional constituents.
3. This summary only considers waterbodies in Category 5. There are several segments listed under Category 3 (*indeterminate – waters needing additional information*) based primarily on citizen monitoring data that may in the future be included in Category 5.

Table F1: Summary of Category 5 waterbodies in Virginia Department of Environmental Quality 2004 Integrated Report with drainage areas in Fairfax County.

No.	Waterbody Name	Impaired Segment extent and Location	Multi-jurisdictional ?[#]	Impairment cause[*]	Listing Date	Scheduled TMDL completion
1	Sugarland Run	5.75 mi (from confluence of Folly Lick Branch to confluence with Potomac River)	Yes (Loudoun)	Fecal Coliform	2002	2014
2	Difficult Run	2.93 mi (from confluence of Captain Hickory Run to confluence with Potomac River)	No	Benthic Fecal Coliform/*E Coli*	1994/2004	2010
3	Pimmit Run	7.38 mi (headwaters of Pimmit Run to confluence with Potomac River)	Yes (Arlington)	Fecal Coliform	2002	2014
4	Tripps Run	2.25 mi (headwaters of Tripps Run to start of Lake Barcroft)	No	Benthic	2004	2016
5	Holmes Run (upper segment)	5.8 mi (headwaters of Holmes Run to start of Lake Barcroft)	No	Benthic	2004	2016
6	Holmes Run (lower segment)	3.59 mi (mouth of Lake Barcroft to confluence with Backlick Run)	Yes (Alexandria)	Fecal Coliform	2004	2016
7	Backlick Run	6.45 mi (headwaters to confluence with Holmes Run)	Yes (Alexandria)	Fecal Coliform	2002	2010
8	Accotink Creek	8.62 mi (confluence of Calamo Branch to the tidal waters of Accotink Bay)	Yes (City of Fairfax)	Benthic Fecal Coliform	1996 2004	2010

[#] Water body drainage includes areas outside Fairfax County.

[*] Water body is considered nonsupporting or partially supporting of one or more of designated uses because water quality standards for constituent(s) listed are not being met.

Table F1: Summary of Category 5 waterbodies in Virginia Virginia Department of Environmental Quality 2004 Integrated Report with drainage areas in Fairfax County (con't).

No.	Waterbody Name	Impaired Segment extent and Location	Multi-jurisdictional ?[#]	Impairment cause[*]	Listing Date	Scheduled TMDL completion
9	Pohick Creek	3.2 mi (confluence of South Run to the end of free-flowing portion of Pohick Creek)	Yes (City of Fairfax?)	PCBs, PAHs in fish tissue	2002	2014
10	Mills Branch	1.81 mi (headwaters of Mills Branch to confluence with the Occoquan River)	No	Fecal Coliform	2002	2014
11	Popes Head Creek	4.92 mi (confluence of Piney Branch to confluence of Bull Run)	City of Fairfax	Benthic Fecal Coliform	1998 2004	2010
12	Bull Run	4.8 mi/5.75 mi (confluence of Cub Run to confluence of Popes Head Creek)	Yes (Prince William, Loudoun, Fauquier)	Benthic Fecal Coliform, PCBs in fish	1994 2004	2010
13	Virginia Tidal waters	20.3 mi^2 (from Woodrow Wilson bridge to Brent Point at mouth of Aquia Creek)	Yes (Alexandria, Prince William,Stafford)	PCBs in fish tissue	2002	2014
14	Hunting Creek/Cameron Run	0.71 mi^2 (0.22 river mile above Telegraph Rd. to confluence with Potomac includes embayment)	Yes (Alexandria)	Fecal Coliform PCBs in fish tissue	1998 2002	2010
15	Little Hunting Creek	0.24 mi^2 (upstream limit of tidal waters to confluence with Potomac River)	No	PCBs in fish tissue Fecal Coliform	2002 2004	2014

[#] i.e. Does waterbody drainage includes areas outside Fairfax County ?

[*] Waterbody is considered nonsupporting or partially supporting of one or more of designated uses because water quality standards for constituent(s) listed are not being met.

Table F1: Summary of Category 5 waterbodies in Virginia Virginia Department of Environmental Quality 2004 Integrated Report with drainage areas in Fairfax County (con't).

No.	Waterbody Name	Impaired Segment extent and Location	Multi-jurisdictional ?[#]	Impairment cause[*]	Listing Date	Scheduled TMDL completion
17	Occoquan Bay	0.69 mi^2 (half-mile radius around monitoring station located in center of bay)	Yes (Prince William)	pH, PCBs in fish tissue	2002	2014
18	Occoquan River	0.05 mi^2 (half-mile radius around monitoring station located at Route 123 bridge)	Yes (Prince William, Fauquier, Loudoun)	PCBs in fish tissue Fecal Coliform	2002 2004	2014
19	Occoquan Reservoir	1,700 ac (start of inundated waters on Bull Run and Occoquan River to lower end of reservoir)	Yes (Prince William, Fauquier, Loudoun)	Dissolved Oxygen (bottom waters)	2002	2010

[#] i.e. Does waterbody drainage includes areas outside Fairfax County ?

[*] Waterbody is considered nonsupporting or partially supporting of one or more of designated uses because water quality standards for constituent(s) listed are not being met.

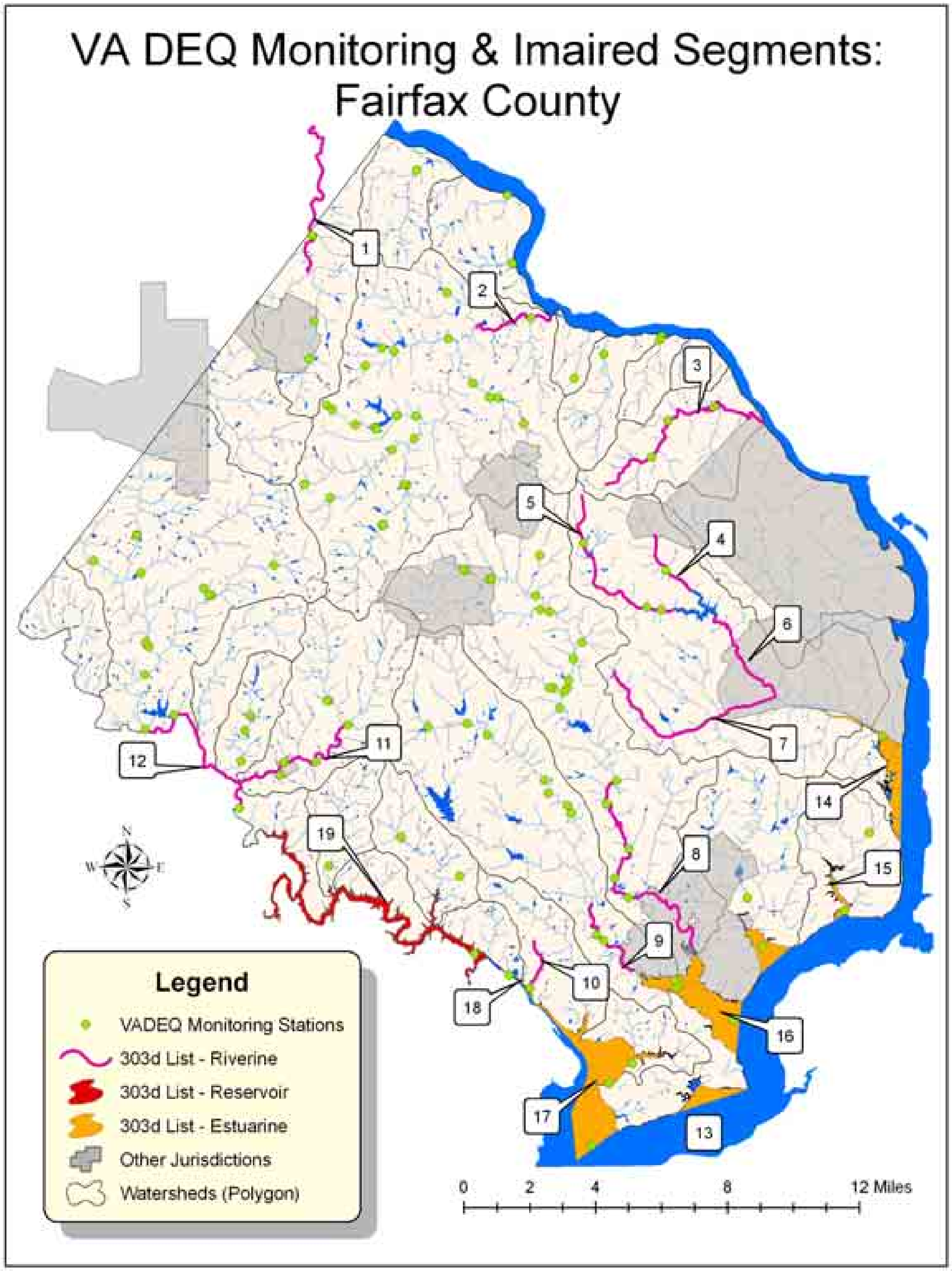


Figure F1: Virginia Department of Environmental Quality monitoring stations and locations of riverine (1-12) and non-riverine (13-19) Category 5 waterbodies in Fairfax County (numbers correspond to those used in Table F1).

G: COMPUTATION OF STRATUM AND OVERALL MEAN AND VARIANCES

A Digital Elevation Model derived synthetic stream network, generated at a 50 acre threshold, was utilized as the sampling frame. The stream network was stratified by Strahler stream order (1st through 5th) and samples allocated according to the proportion of total stream length in each stratum (Figure G1).

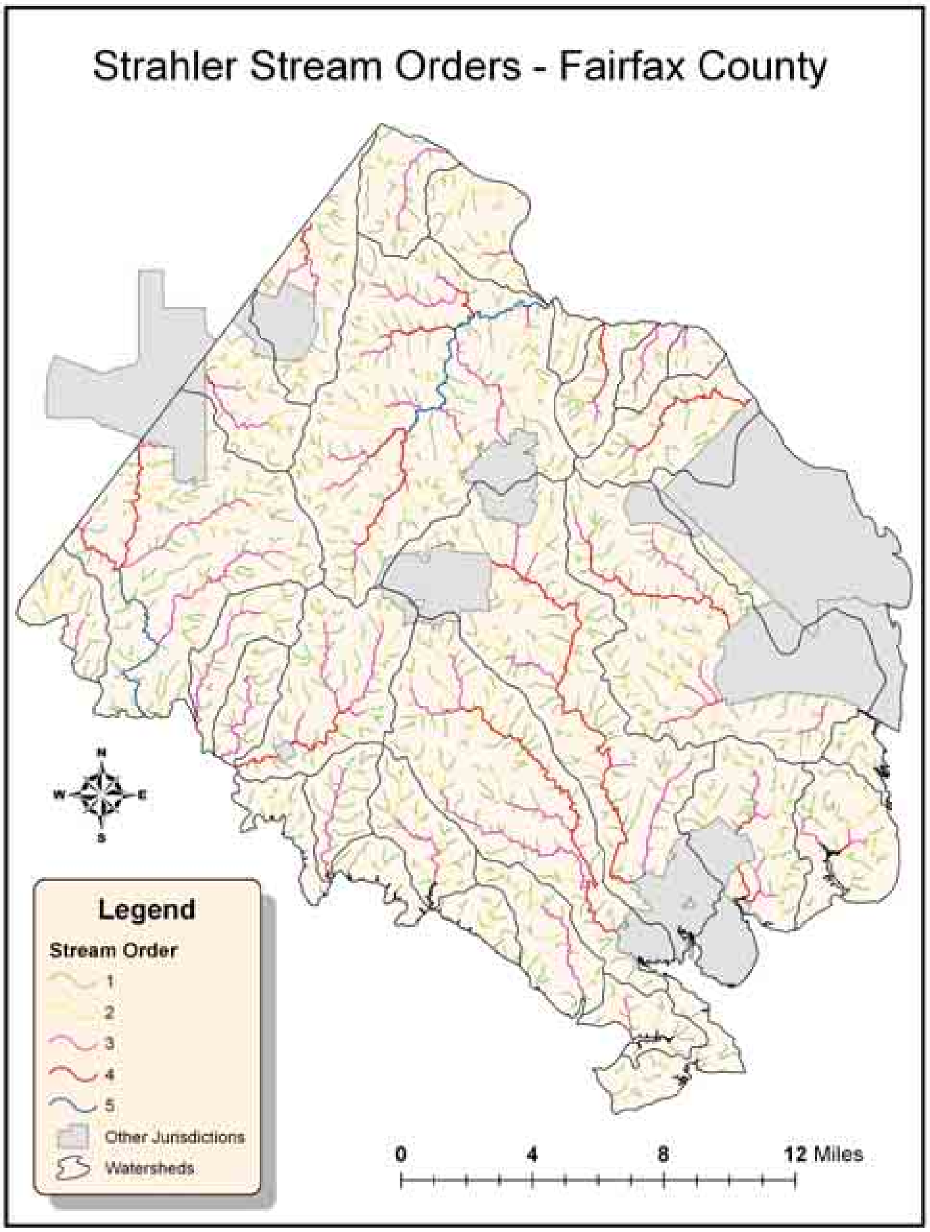


Figure G1: Digital Elevation Model derived stream sampling frame.

Stratum weights were therefore calculated as

$$W_h = \frac{L_h}{L_T}$$

where W_h is the weight of stratum *h*, L_h is the total stream length in the stratum, and L_T is the total stream length for the strata under consideration,

$$L_T = \sum_{h=1}^{n_s} L_h$$

and where n_s is the number of strata of interest. The sum of all weights must equal unity as

$$\sum_{h=1}^{n_s} W_h = 1 / L_T \sum_{h=1}^{n_s} L_h = 1.0$$

A two-stage procedure was employed to determine sampling locations. Within each stratum, a stream segment was first selected at random. A sampling location was then randomly selected within this segment. The segment was then replaced, and the process repeated to obtain the required number of samples in each stratum.

Sample means and variances within each stratum were calculated based on computational procedures presented by Cochran (1977) and Gilbert (1987) for two-stage sampling when primary units are of unequal size and have the same chance of being selected. Stratum means were computed from

$$\bar{I}_h = \frac{\sum_{i=1}^{n_h} L_i I_i}{\sum_{i=1}^{n_h} L_i}$$

where $\bar{I}_h$ is the mean index in stratum *h*, I_i is the index value of the *ith* sample in the stratum, L_i is the length of the segment on which the *ith* sample was taken, and n_h is the number of samples taken in the stratum. If the total number of segments in each stratum is large compared to the number of segments sampled, then,

$$s_h^2 = \frac{1}{\overline{L}_h^2 (n_h - 1)} \sum_{i=1}^{n_h} L_i^2 (I_i - \bar{I}_h)^2$$

where s_h^2 is the index variance in stratum *h*, and is the mean segment length in the stratum.

The overall mean ($\bar{I}_o$) and variance (s_o^2) across two or more strata are obtained as

$$\bar{I}_o = \sum_{h=1}^{n_s} W_h \bar{I}_h$$

$$s_o^2 = \sum_{h=1}^{n_s} W_h^2 s_h^2$$

+

The variance of the overall mean , $s_o^2(\bar{I}_o)$, is computed as

$$s_o^2(\bar{I}_o) = \sum_{h=1}^{n_s} \frac{W_h^2 s_h^2}{n_h}$$

H: OTHER MONITORING EFFORTS

Stormwater Planning Division

National Pollutant Discharge Elimination System (NPDES) Requirements
Section 402 of the Clean Water Act established the National Pollutant Discharge Elimination System to limit pollutant discharges into streams, rivers, and bays. The Department of Conservation and Recreation is the issuing authority of the county's Virginia Pollutant Discharge Elimination System – Municipal Separate Storm Sewer (VPDES-MS4) Permit 0088587. The county's comprehensive stormwater management program focuses on seven major areas to meet the federal and state regulations in the permit:

- watershed management planning;
- capital improvements and infrastructure retrofits;
- maintenance and operations of existing infrastructure;
- strategic initiatives, policy, management, and emergency response;
- monitoring and assessments; and
- public outreach and education

The monitoring and assessment section of the annual report discusses the county's ongoing monitoring and watershed assessment program, which includes:

- dry weather screening
- wet weather screening
- industrial and high risk runoff program
- watershed monitoring
- water quality monitoring
    - bioassessment
    - bacteria
- floatable monitoring

As required by the county's permit, an annual report is prepared by the Stormwater Planning Division staff. The 2003 and 2004 reports are available on-line at:

www.fairfaxcounty.gov/dpwes/stormwater/ms4permit.htm

Kingstowne and South Van Dorn Monitoring Stations
Fairfax County staff has managed the Kingstowne Environmental Monitoring Program since 1986. This program assists the county in evaluating the sediment removal efficiencies of erosion and sediment controls installed at the developing Kingstowne tract, as well as provides data on nutrient and heavy metal loadings to Dogue Creek. The U.S. Army Corps of Engineers permit required the developing South Van Dorn road extension to install a second station, in 2002 to evaluate nutrient loadings and removal efficiencies by stormwater management facilities from the entire Silver Springs segment of the Dogue Creek watershed.

Countywide Stream Physical Assessment
A countywide stream assessment project was initiated by the Stormwater Planning Division of the Department of Public Works and Environmental Services in the spring of 2002.

The services of CH2M HILL were retained to conduct assessments of approximately 800 stream miles countywide. The assessments included an evaluation of overall stream habitat and physical conditions and descriptions of features such as stream crossings, stormwater drainage pipes, utility crossings, streambank erosion, deficient buffers, and stream obstructions.

The completion of the stream assessment project represents a major milestone in the County's watershed planning program, and will provide necessary information for the development of management plans in each of the County's watersheds.

Data from this project will allow a more comprehensive understanding of streams and watersheds in Fairfax County. The data will be integrated with other watershed and stream assessment information to develop predictive tools for evaluating the impact of watershed changes on stream quality.

Accotink Creek Bacteria Source Tracking Study
A 4.5 mile stretch of Accotink Creek, immediately upstream of Lake Accotink was placed on the 1998 state's 303(d) list for a fecal coliform Total Maximum Daily Load (TMDL).

With a goal of reducing human inputs into the stream by 99 percent, Stormwater Planning Division staff partnered with the United States Geological Survey (USGS) to identify human inputs of wastewater into the system throughout the upper Accotink Creek watershed. The USGS and the division are cooperating with the Virginia Department of Conservation and Recreation and the City of Fairfax with this project.

Federal Monitoring Efforts: United States Geological Survey (USGS)
The USGS investigates the occurrence, quantity, quality, distribution, and movement of surface and underground waters and disseminates the data to the public, state and local governments, public and private utilities, and other federal agencies involved with managing the nation's water resources. Surface-water data are collected by field personnel or relayed through telephones or satellites to offices where it is stored and processed. Once a complete day of readings are received from a site, daily summary data are generated and stored in the data base. Annually, the USGS finalizes and publishes the daily data in a series of water-data reports. Daily streamflow data and peak data are updated annually following publication of the reports (USGS, 2005).

The USGS has collected streamflow data for varying lengths of time at 11 stations in Fairfax County. Two of those stations are still active:

- USGS 01646000, Difficult Run near Great Falls, has been sampled since 1935 and has data record of 25,020 daily streamflow values.
- USGS 01654000, Accotink Creek near Annandale, has been sampled since 1947 and has data record of 20,454 daily streamflow values.

The USGS also collects and analyzes chemical, physical, and biological properties of water, sediment and tissue samples from across the Nation. At selected surface-water and ground-water sites, the USGS maintains instruments that continuously record physical and chemical characteristics of the water including pH, specific conductance, temperature, dissolved oxygen, and percent dissolved-oxygen saturation. Supporting data such as air temperature and barometric pressure are also available at some sites. The USGS has collected water quality data for varying lengths of time at 106 stations in Fairfax County.

Low Impact Development (LID) Projects

Federal and State guidelines are placing an increasing emphasis on controlling stormwater runoff close to its source. Environmentally sensitive site design and low impact development practices that serve to minimize impervious cover and replicate natural hydrologic conditions are widely recommended approaches for accomplishing this goal. The county's Environmental Agenda calls for better site design practices that protect our streams and other natural resources. Fairfax County's objective is to encourage the use of low impact development concepts and techniques, especially in new residential and commercial areas, and seek opportunities for retrofitting established areas.

- ***Stormwater Retrofit—Providence Supervisor's Office***

  This low impact development demonstration project is located within the Accotink Creek watershed. In addition to the Providence Supervisor's Office, the site is also the location of the county's Merrifield Fire Station. The Department of Public Works and Environmental Services and Northern Virginia Soil and Water Conservation District are partnering in the analysis, design and construction. The overall complex encompasses a land area of 1.8 acres with approximately 1.44 acres being impervious surfaces. The proposed work will serve as a highly visible demonstration project featuring three practices: a bioretention basin (rain garden), a green roof, and permeable pavers. The bioretention basin and permeable pavers with underlying gravel infiltration bed will allow runoff to drain into a retention area where it can then slowly infiltrate into the surrounding soil. The green roof installation on an existing concrete storage structure will serve to reduce rooftop stormwater runoff and provide a comparison to an adjacent storage structure with a conventional roof. These three integrated practices will work in harmony to address both water quality and water quantity retrofit goals on the site. This site will be monitored by the department for water quality and quantity both entering and exiting the bioretention basin.

- ***Yorktowne Square Green Roof***

The 5,000-square-foot green roof at Yorktowne Square Condominium is one of the first retrofitted green roofs in the state. Building Logics' German design green roof system was chosen because it is lightweight and the 35-year-old building has structural limitations. There were 8,400 sedums planted on the roof. A pair of cisterns have been set up to measure the effectiveness of the green roof in reducing water runoff by measuring the volume of water draining from the green roof and an identical roof without vegetation. In addition, the water runoff from both roofs will be tested to measure any filtering qualities the green roof may provide. The Stormwater Planning Division will be taking over the monitoring of this site.

Yorktowne Square green roof

State Monitoring Efforts: Virginia Department of Environmental Quality

Water quality monitoring has been ongoing in Virginia for decades. In 1997, the Virginia General Assembly enacted the Water Quality Monitoring, Information, and Restoration Act, which provides the Virginia Department of Environmental Quality (DEQ) with a mandate to perform a minimum amount of water quality monitoring. In accordance with WQMIRA, monitoring programs are developed for the maintenance, support and restoration of surface waters with regard to the following uses: aquatic life, drinking water, recreation, fishing and shellfish consumption (VADEQ, 2003). The following monitoring programs are implemented to accomplish this:

- Ambient Watershed: represents the largest single section of the monitoring program. Stations are sampled every other month for two years and then rotated to a new set of stations, completing a statewide cycle in six years.
- Coastal 2000: federally funded tidal probabilistic program designed by U.S. EPA and sampled by Virginia Department of Environmental Quality staff.
- Chesapeake Bay: designed through the U.S. EPA Chesapeake Bay Program Office and encompasses a multi-state water quality characterization effort.
- Citizen Monitoring: stations in segments identified through public participation as targeted for specific monitoring by Department of Environmental Quality.
- Facility Inspection: integral to determining compliance with discharge limits.
- Freshwater Probabilistic: program covers the nontidal free flowing waters of the state and is designed to characterize the overall water quality of free-flowing streams in Virginia.

- Fish Tissue: conducted by central office staff from the Office of Water Quality Standards to determine the human health risks associated with consuming fish. Stations are rotated through the state in a five-year cycle.
- Incident Response: similar to pollution complaints but are not of petroleum in origin.
- Pollution Complaints: special samples collected as a result of a petroleum spill.
- Pfiesteria Monitoring: in cooperation with the Virginia Department of Health, monitors tidal portions of the state for the presence of Pfiesteria.
- Quality Control: generally between two and ten percent of the samples collected under each of the individual programs are quality control samples.
- Regional Biological: determines the health of the benthic macro invertebrate community as a tool to determine water quality conditions and follows the U.S. EPA Rapid Bioassessment Protocol II.
- Reservoir Monitoring: the largest lakes are sampled every year, and the others are sampled based on a rotating schedule.
- Special Studies: specialized, intensively targeted monitoring efforts designed to answer specific questions related to water quality conditions.
- TMDL: associated with the development of a TMDL implementation plan for segments listed on the 303(d) list.
- Trend: long-term stations sited for permanent monitoring for the purpose of detecting short-, medium- and long-term water quality trends for a wide variety of environmentally important water quality parameters.
- Carryover: usually have small data sets that indicate a potential problem and will be sampled until data sufficient to assess water quality conditions.

In FY 2004 (July 1, 2003 through June 30, 2004), the Department of Environmental Quality sampled 20 stations in Fairfax County, primarily for residue (filterable and non-filterable), turbidity, total nitrogen, total phosphorus, and bacteria (VADEQ, 2005). Data collected by DEQ and other agencies with approved QA/QC procedures is used to develop the Integrated 305(b) and 303(d) report which identifies waters that are not supporting their designated uses and lists them as impaired. A Total Maximum Daily Load (TMDL) outlining the reductions in pollutant sources required to restore water quality must be developed for all impaired waters. A summary of impaired waters and Total Maximum Daily Load development activities in Fairfax County is presented in Appendix F.

Regional Monitoring Efforts

<u>Occoquan Watershed Monitoring Laboratory</u>

The Occoquan Watershed, which lies in the southwest portion of the County, consists of all the land, including tributary streams, draining into the Occoquan Reservoir, one of the County's two primary sources of drinking water. Seventeen percent of the watershed, or roughly 64,500 acres, lies in the County. The rest of the 590 square-mile watershed lies in parts of Prince William, Fauquier, and Loudoun counties. In July of 1971, the State Water Control Board adopted the Occoquan Policy, which recognized that an indirect re-use of treated wastewater would become the operational norm in the

Occoquan Watershed. In order to protect the public health, the Policy not only specified the type of waste treatment practice to be adopted on a basin-wide scale, but also provided for an ongoing program of water quality monitoring to quantify the success of the water quality protection effort. The Occoquan Watershed Monitoring Subcommittee created an independent facility to conduct the required monitoring program. The resulting facility, the Occoquan Watershed Monitoring Laboratory, was established by the Virginia Polytechnic Institute Department of Civil Engineering. The laboratory began its on-site operations in 1972, and has since developed a comprehensive database of water quality in the Occoquan Basin (New Millennium Occoquan Watershed Task Force, 2003).

The laboratory maintains a network of nine stream gaging stations in the watershed, three of which are located in Fairfax County (OWML, 2005). These stations are:

- ST40, located on Bull Run where it flows into the Occoquan Reservoir
- ST45, located on Bull Run at the bridge on State Highway 28 (Centreville Road)
- ST50, located on Cub Run at the bridge on State Highway 658 (Compton Road)

In addition to gaging streamflow, the laboratory also monitors for a host of organic and chemical pollutants, including total nitrogen, total phosphorus, total suspended solids, turbidity, chemical oxygen demand, foaming agents, and a number of non-volatile synthetic organic chemicals. The sampling stations are configured with equipment and instrumentation to allow the automatic retrieval and storage of samples during all storm events. The analytical results of such samples, combined with streamflow data, allow the laboratory to make accurate calculations of loads of various chemical constituents (New Millennium Occoquan Watershed Task Force, January 27, 2003).

<u>Reston Association – Environmental Monitoring Program</u>

The Reston Association has been monitoring the water quality of lakes Anne, Thoreau, Audubon and Newport, since 1981; Lake Newport was added to the monitoring program in 1982. Additional sampling of Bright Pond and Butler Pond were added in 2003. The monitoring and annual reports are completed by Aquatic Environment Consultants. The annual reports are used by the association for monitoring long-term trends and general lake management purposes. Information is submitted for Environmental Quality Advisory Council's consideration and inclusion in their Annual Report on the Environment.